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Einstein

WITH the death of Albert Einstein in April of 1955, physicists lost their greatest colleague. For two golden decades early in this century, the history of Einstein's discoveries is inseparable from the history of physics.

Einstein started with the nineteenth century developments of statistical mechanics and of electromagnetic theory as his inheritance. In the first year of his fully mature work, his paper on Brownian movement enlarged and defined statistical theory, and led to those insights into fluctuations which were to play so great a part in Einstein's contributions to quantum theory. In a second great paper he formulated with full incisiveness the hypothesis of light quanta, and irrevocably changed our understanding of physical processes on the atomic scale. In a third paper he made the special theory of relativity. Many of the results contained in his paper were to be found also in independent and concurrent publications of Lorentz and Poincaré; but only Einstein saw the role that in principle the finite velocity of light plays in determining the nature of our observation and definition of simultaneity, and of intervals of space and time, and thus the deep logical inevitability of a phenomenon only much later to be established experimentally: that clocks in motion by virtue of that motion go more slowly.

From then on, for the next decade, Einstein was to be preoccupied with the problems of inertia, of mass, of acceleration, and of gravity. He discovered first the identity of mass and energy, which was to be verified in detail only some twenty-five years later, and was to provide the basis for such fateful developments for man's whole history during and since the second world war. He began to understand the import of the precise equality of inertial and gravitational mass, and to see in this the foundation for a geometrical theory of gravitation. He sought to preserve the logically necessary general covariance of the equations of physics, until this long effort was crowned with the discovery of the general theory of relativity and the field equations. He was almost at once able to define three crucial experiments, accessible through existing observational techniques, by which the novel implications of his theory could be compared with experience. In the forty years that have elapsed these have remained the principal and, with one exception, the only connections between the general theory and experience. The exception lies in the field of cosmology, where Einstein himself was the first to see wholly new approaches opened by the theory of relativity. More than any other great advance in physics, the general theory of relativity is the work of one man. Without him, it might have lain long undiscovered.

During this whole period Einstein was very close to the rapidly evolving quantum theory of atomic phenomena. He reverted to the use of statistical arguments, and to the logical meaning of fluctuations, to discover the laws of emission and absorption of radiation, and to establish the connection between the waves of de Broglie and the statistical laws proposed by Bose from the description of light quanta. As this period drew to a close with the discovery in 1925 of the quantum mechanics, and its more and more definitive formulation, especially by Bohr, Einstein's role was to change. He found himself from the first disturbed and unsatisfied by the statistical and acausal character of the new mechanics, to the discovery of which he had made such great contributions.

In a long period of brilliant discussion and analysis, especially with Ehrenfest and with Bohr, he attempted again and again to show that the new mechanics, for all its vast agreement with experience, contained logical errors and inconsistencies. Yet, as example after example, upon analysis, only confirmed the harmony and consistency of the quantum theory, he was led to accept this; but to it he always coupled his unaltered conviction that this should not be the ultimate description of the atomic world, and that in an ultimate description acausal and statistical features must be eliminated.

Thus, for the last decades of his life he did not share in full the convictions or the interests of the great majority of his colleagues. Instead, with increasing single-mindedness, he turned his attention to the discovery of what would for him have been a basic and satisfying account of the atomic nature of matter. This was the program of the unified field. Here he sought to generalize the matter-free field equations of general relativity so that they might also account for electromagnetic phenomena. He sought equations whose solutions would correspond to local aggregations of mass and charge, and whose behavior would resemble the atomic world so well described by quantum theory. He was hard at work on this program until his death. It was a program that did not arouse the hope or indeed the active interest of many physicists; yet his knowledge of their work, and his judgment of it, remained firm and masterful; and he was never deceived by any of the proposed causal reinterpretations of atomic physics.

When the weather was good enough, Einstein would walk home from work. One day not long ago he said to me "When it has once been given you to do something rather reasonable, forever afterward your work and life are a little strange." It had indeed been given him to do something reasonable. His presence among us stayed us from the worst folly, and touched those who knew him with the light of magnanimity.

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